6. INDUSTRIAL FUGITIVE EMISSION CONTROLS

This section describes measures used to control fugitive PM emissions from industrial sources. Fugitive PM emission sources can be divided into two broad categories--process fugitive emission sources and fugitive dust emission sources. Process fugitive emissions sources include emissions from mechanical and metallurgical operations that receive and/or generate dusty material. Fugitive dust emission sources relate to the transfer, storage, and handling of dusty materials and include those sources from which particles are entrained by the forces of nature acting on exposed dusty surfaces or from vehicle motion on dusty roads.

The most widely used methods of controlling process fugitives are local ventilation and building enclosure/evacuation. Both types of systems have their advantages and drawbacks, but local ventilation is generally more cost effective. Process optimization, good operation and maintenance (O&M), and other industry-specific practices can also be quite effective in reducing process fugitive emissions. However, both the selection of the system and the ultimate performance of the system are related to industry and facility-specific design and operating characteristics.

For most industrial plants, paved and unpaved roads are the primary sources of fugitive dust emissions. Fugitive dust emissions from handling operations for storage pile materials are usually less significant in comparison to road sources, unless the moisture content of the storage pile materials is extremely low. Emissions due to wind erosion of storage piles are likewise less significant unless wind speeds are unusually high.[1] Low wind speeds can result in significant emissions if storage pile materials are fines (e.g. cement kiln dust or materials collected by fabric filters or ESPs)

The control of road dust from both paved and unpaved roads, therefore, can achieve a significant reduction in fugitive dust emissions. Paving of unpaved roads; eliminating, reducing, or managing truck transportation; and street cleaning are the most effective techniques to reduce fugitive dust emissions from roads.

More information about fugitive dust emission sources and controls can be found in the EPA publications *Fugitive Dust Background Document and Technical Information Document for Best Available Control Measures*,[2] and *Compilation of Air Pollutant Emission Factors (AP-42), Volume I: Stationary Point and Area Sources*.[3]

6.1 ENCLOSURES AND VENTILATION

Partial or full enclosures, windbreaks, hoods and other ventilation systems, and complete building evacuation are widely used methods to capture and control fugitive PM emissions. These methods are usually used with traditional stack PM control devices (e.g. fabric filters or scrubbers) to collect the captured PM. Processes amenable to this type of control include materials handling devices such as conveyors, elevators, feeders, loading and unloading operations, and bagging; solids benefication, such as crushing, screening, and other classifying operations; mining, i.e. drilling and crushing; and furnaces, ovens, and dryers.[7]

6.1.1 Local Ventilation Systems

Local ventilation systems can consist of a "secondary" hood at a localized source of PM emissions or large canopy-type hood suspended over the entire source. An example of a secondary local hood is a mobile hood that is used to collect emissions from pots or other containers that are set aside for cooling. Ventilation systems are usually uniquely designed to conform with the facility configuration and need for process access; these factors, however, can limit their performance as well as their design. Ventilation hooding and its ductwork may be difficult to retrofit in some facilities due to space limitations. In addition, local ventilation systems may limit personnel and equipment access. For these reasons, a local ventilation system may not be a feasible method of process fugitive emissions control for some operations. Design information about local ventilation systems in general and for specific applications can be found in the most recent edition of the American Conference of Governmental Industrial Hygienists (ACGIH) publication: *Industrial Ventilation: A Manual of Recommended Practice*.

Most ventilation systems are designed to meet several objectives.[1] First, the hood must enclose the source to the degree possible without excessively interfering with the access needed for normal operations. Second, the hood should be configured in such a way that natural buoyancy or mechanical forces direct the plume into, rather than away from, the hood. Finally, the system must be designed with sufficient exhaust ventilation to maintain recommended face velocities at all hood faces. Typically, these velocities are in the range of 75 to 150 meters per minute. Additionally, for buoyant plumes that generate a natural draft, the ventilation rate must exceed the plume generation rate, or "spillage" from the hood will occur.[1]

Metal operations, both primary and secondary, generate a large quantity of fugitive PM emissions. One of the major sources of metallurgical process fugitive emissions that can be controlled by local ventilation are stationary-type furnaces such as blast furnaces, reverberatory furnaces, and cupolas. Hoods may be designed to collect gas perpendicular to the buoyant gas flow, in which high face velocities are required; other designs may be such that the buoyant gas plume is directed into the hood. Figure 6-1 shows a local ventilation system at a blast furnace slag tapping area.[1,4] A very different local ventilation design would be needed for nonstationary electric arc and rotary furnaces that rotate during operation. A key feature of these systems is that charging and tapping occur in the same general area. Hence, hooding must be designed in such a way that it does not interfere with either operation.

Material handling operations can also be equipped with local ventilation to control fugitive PM emissions. Figure 6-2 shows a local ventilation system at "skip hoist" loading station that is part of a metallurgical operation.

An air curtain capture system is a specially designed local ventilation system that can capture fugitive emissions from a process without interfering in normal operations, such as the use of an overhead crane. With an air curtain, air is blown across the space above the PM-generating operation using a plenum or row of nozzles designed to form an air sheet which causes as little turbulence as possible. The curtain air, entrained air (from above and below the curtain) and PM, including fine PM fumes, are captured by the exhaust system. Capture of

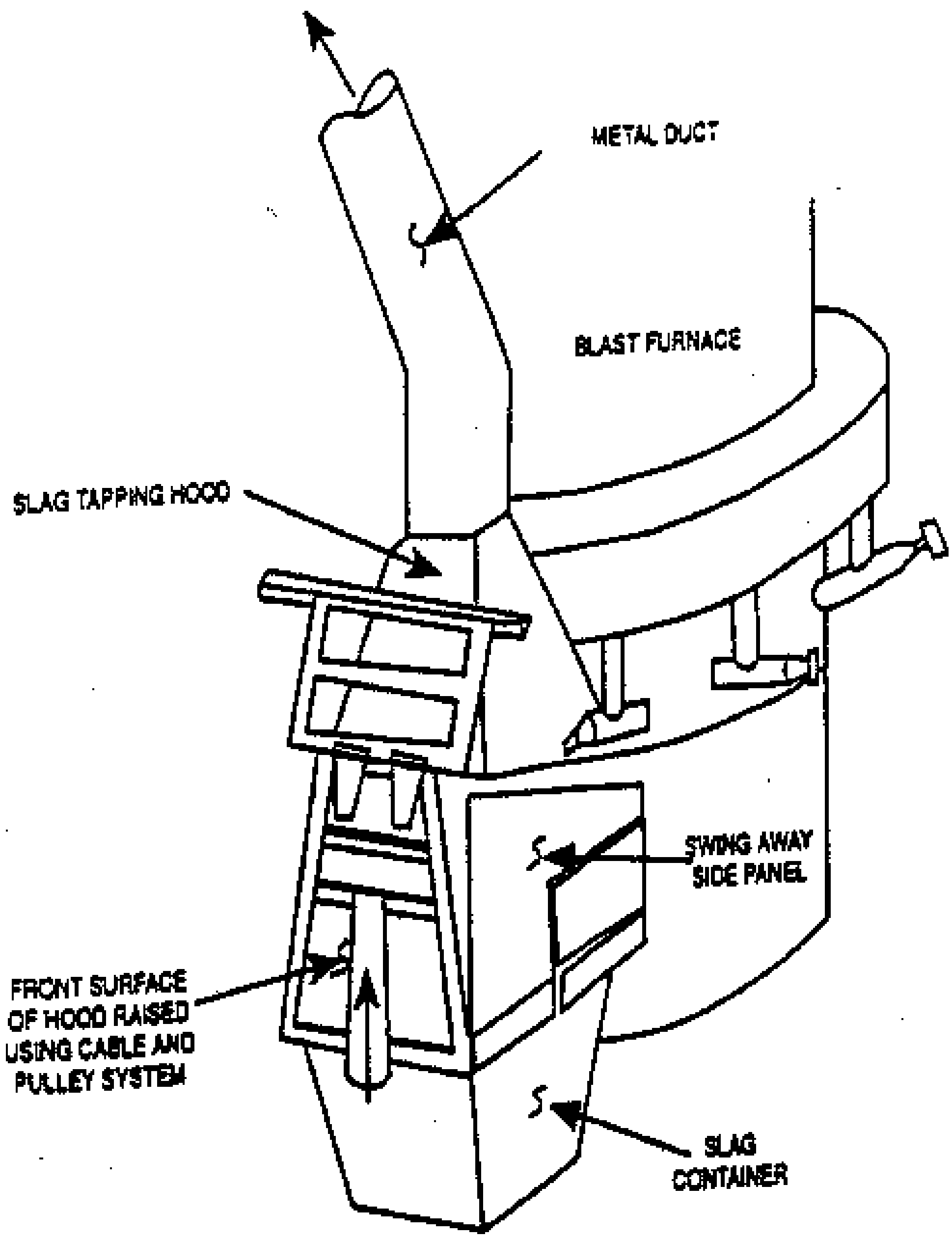

Figure 6-1. Schematic of a Slag-tapping Hood at a Blast Furnace (from Reference 4).

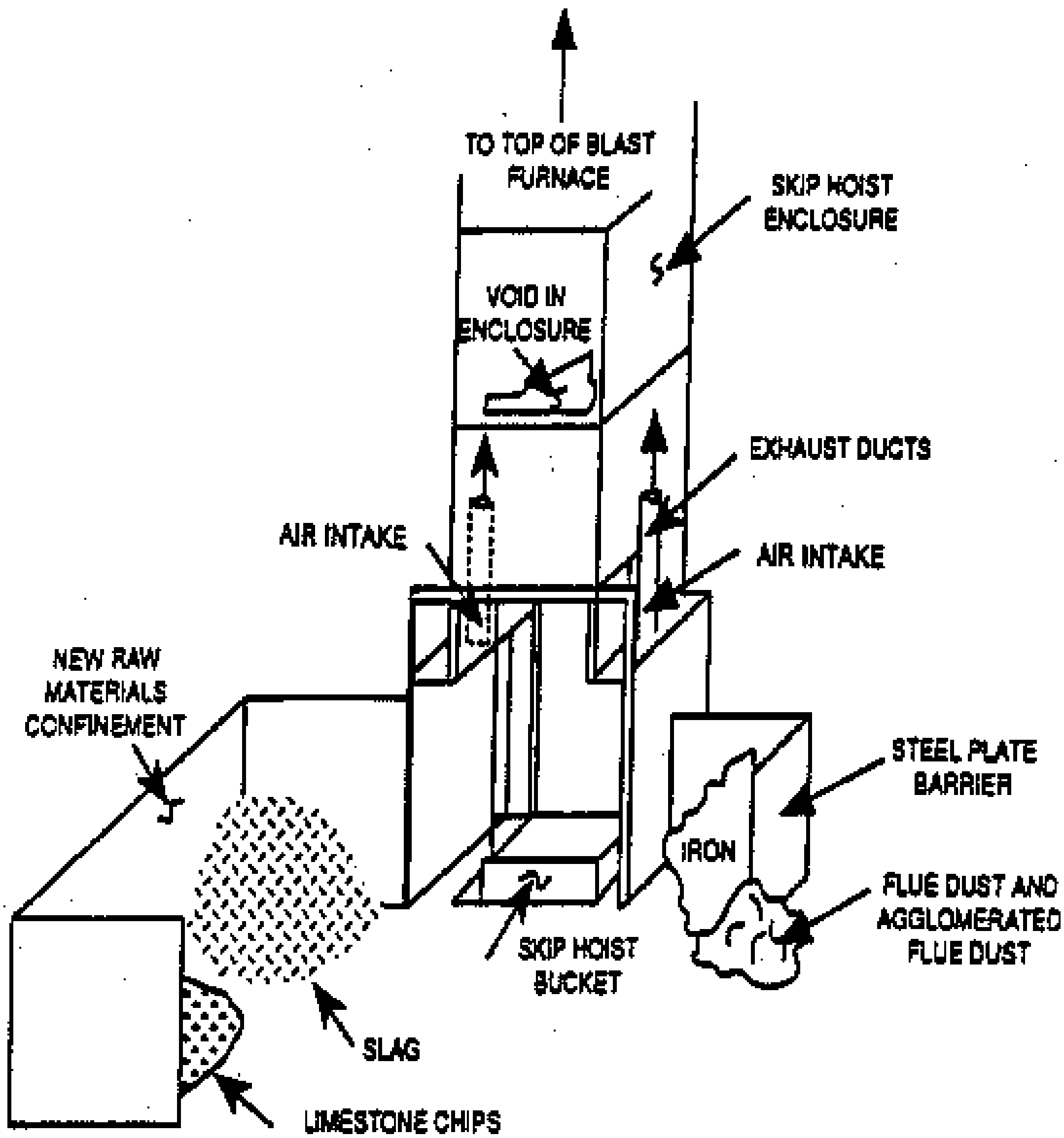

Figure 6-2. Schematic of a Local Ventilation System at a "Skip Hoist" Loading Station

fugitive PM is greater than 90 percent. This type of system has been used successfully in primary copper production.[1]

6.1.2 Building Enclosure/Evacuation

Enclosing and ventilating an entire building may be the only feasible control method when the process operation is characterized by a number of small fugitive emissions sources. A typical building evacuation system might consist of opposing wall-mounted ventilators that force air across process equipment and out through an overhead plenum to a fabric filter.[5] In order to limit worker exposure to emissions and expel the heat generated by process operations, large airflow rates are required. Thus, operational costs for this type of system can be prohibitive. In addition, the need to keep the building enclosed during operation of the ventilation system may be too restrictive on process operations, such as the movement of forklifts and other equipment into and out of the building.[1]

6.2 OPTIMIZATION OF EQUIPMENT AND OPERATION

Optimization of equipment and operation includes: 1) limiting the amount of dust available for emissions; 2) improving the arrangement of materials that generate dust; 3) optimizing the process so that less dusty material is used, generated, or made vulnerable to air contact; 4) preventing or minimizing leaks; and 5) other good O&M procedures that reduce PM emissions. In some industries, optimizing equipment and operation to reduce PM emissions can also reduce operating costs if valuable products and/or raw materials can be recovered and used.

6.2.1 Source Extent Reduction and Improvement

Source extent reduction measures are largely a function of good work practices and include measures designed to reduce the volume and/or area of PM-generating materials disturbed or reduce the frequency of disturbances and spills.[1,7] These goals can generally be achieved through good work practices and without a large investment in a control program.[1]

Examples of source extent reductions/improvements include:[1]

- Drop height reduction through the use of hinged-boom conveyors, rock ladders, lower wells, etc.[7] Table 6-1 lists estimated control efficiencies for improvements through drop height reduction techniques;[6]

- Use of less dusty raw materials;

- Choke-feed or telescopic chutes to confine the material being transferred;[7]

- Increasing moisture retention in dusty areas;[1]

Table 6-1. Estimated Control Efficiencies for Drop Height Reduction Techniques (from Reference 6)

Technique	Control Efficiency (percent)
Lowering well or perforated pipe	80
Telescoping chute	75
Rock ladder	50

- Washing down or scraping conveyor belts regularly;[1]
- Performing PM-generating activities only as needed, e.g. in secondary lead production, breaking of batteries only as needed to keep pace with the furnace;[1]
- Monitoring of feed materials to identify high PM-generating conditions;[1]
- Use of clean scrap in metal-melting furnaces;[7] and
- Removing crankcase oil prior to automobile salvage.[7]

6.2.2 Process Optimization/Modification

Process optimization and/or modification can be an effective preventive measure for process fugitive emission control. Also included in this category is the optimization of the primary PM control devices and their capture systems. Some general techniques are:

- Mass transfer frequency reduction,
- Improved operational efficiency, and
- Use and proper operation of point-of-generation dust collection devices.

Some process-specific optimization techniques are:

- Designing a sulfuric acid plant at a primary lead smelter with sufficient capacity to preclude the creation of back pressure and excess venting of the sinter machine.[1]

- Changing from a cupola to an electric arc furnace.[7]

- Changing from an (open) bucket elevator to more efficient (closed) pneumatic conveyor.[7]

- Screening out undersized coke (<1 inch) to reduce blast furnace fugitive emissions in primary lead smelting.[1]

- Improving blast furnace combustion efficiency during primary lead smelting by improving the furnace water cooling system.[1]

- Injecting molten sodium in primary lead smelting kettle drossing to form liquid matte rather than dross.[1]

- Eliminating fugitive PM from transporting, pouring, and stirring molten lead by the use of continuous kettle drossing rather than manual in primary lead smelting (as is currently done in only foreign facilities).[1]

- Improving raw material quality, e.g. improve the quality of coke and sinter concentrate used in primary lead production.[1]

- Cooling lead pots to reduce fume generation during kettle drossing in primary lead production.[1]

- Pumping (primary) lead directly to dross kettles using an electromagnetic pump.[1]

- Agglomerating blast furnace flue dust in an agglomerating furnace to reduce the load on the baghouse to improve its performance. This process completely eliminates handling of the dust and the associated fugitive emissions, and eliminates fugitive emissions from flue dust storage piles.[1]

- Using permanent mold castings in gray iron foundries instead of green sand. This is reported to reduce PM emissions by 99 percent.[1]

- Pre-treating glass manufacturing raw materials to reduce the amount of fine particles. Pretreatments include: presintering, briquetting, pelletizing, or liquid alkali treatment.

- Replacing grease and oil lubricants (e.g. in glass manufacturing) with silicone emulsions and water-soluble oils that eliminate the smoke generated from flash vaporization of hydrocarbons from greases and oils that come into contact with process materials.[1]

6.2.3 Leak Prevention and Detection and Other Good O&M Practices

Good O&M practices can help to reduce fugitive PM emissions significantly. A key aspect of a good O&M program to reduce PM emissions is a formalized leak prevention and detection program. Examples of items that may be included in a program are: 1) adequate design and prompt repairs of exhaust hood leaks; 2) maintenance of door and window seals;[1] and 3) repair and/or prevention of warpage of oven doors to maintain proper seal.[7]

Good housekeeping practices and/or prompt response to process upsets, accidents, and spills are also key elements in the control of fugitive dust. This prevents the build-up of dusty material that can be resuspended into localized drafts. Good housekeeping practices include the following procedures:[1]

- Washing down of building interiors regularly,
- Wetting floors during high dust periods,
- Use of oil-based sweeping compounds,
- Wet-wiping drums after the packaging of products,

A central vacuum system may be cost-effective for especially dusty operations.[1] A full-time clean-up crew may be required for some facilities to regularly implement the above procedures.[1,7]

The proper operation of equipment is a good industrial practice to prevent fugitive dust emissions. One example that may be applicable to a number of industries, especially in metallurgy, is the operation of furnaces so that they are not overloaded to eliminate the possibility of back pressure from the primary PM control system as well as "puffing" during opening of the charging door.[7] Employee incentive programs to limit fugitive dust emissions also have been used successfully in some industries.[1]

6.3 COSTS OF HOODS

Chapter 10 of the *OAQPS Cost Manual* provides information on estimating costs for circular canopy, rectangular canopy, push-pull, slide-draft, and back-draft (slotted) hoods.[8] Hood costs are estimated by using parameters from Table 6.2 in the following equation:

$$C_h = aA_f^b \qquad (6.1)$$

where C_h = hood cost ($)
A_f = hood inlet (face) area (ft^2)
a,b = equation regression parameters

6.4 FUGITIVE DUST CONTROL

For information on the control of fugitive dust, please refer to *Fugitive Dust Background Document and Technical Information Document for Best Available Control Measures* (EPA-450/2-92-004) and *Control of Open Fugitive Dust Sources* (EPA-450/3-88-008).

Table 6.2. Parameters for Hood Cost Equation (Reference 8)

Type of Hood	Fabrication Material[a]	Equation Material a	b	Equation Range (A_f, ft^2) [b]
Canopy, circular	FRP	123	0.575	2 - 200
Canopy, rectangular	FRP	294	0.505	2 - 200
Push-pull	FRP	595	0.318	2 - 200
Side-draft	FRP	476	0.332	2 - 200
Back-draft, slotted[c]	PVC	303	1.43	0.6 - 2.0
Back-draft, slotted[d]	PVC	789	0.503	1. 1- 2.1
Back-draft, slotted	PP	645	0.714	1. 1- 2.1
Back-draft, slotted	FRP	928	0.516	1. 1- 2.1
Back-draft, slotted	Galvanized Steel	688	0.687	0.5 - 1.3

a FRP = fiberglass reinforced plastic, PVC = polyvinyl chloride, PP = polypropylene

b For slotted hoods, equation range indicates the range in the area of the slot openings, which is much less than the total face area.

c Hoods with two rows of slots and no dampers.

d Hoods with four rows of slots and manual slot dampers.

6.5 REFERENCES FOR SECTION 6

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